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| **TRANSMITTAL FORM** (to be used for all correspondence after initial filing) | | Application Number | 10/810,960 |
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| | | Filing Date | March 25, 2004 |
| | | First Named Inventor | David J. Edlund |
| | | Art Unit | 1745 |
| | | Examiner Name | Tracy Mae Dove |
| Total Number of Pages in This Submission | 32 | Attorney Docket Number | NPW 357 |

## ENCLOSURES (*Check all that apply*)

- [x] Fee Transmittal Form (in duplicate)
  - [x] Fee Attached
- [ ] Amendment/Reply
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [ ] Express Abandonment Request
- [ ] Information Disclosure Statement
- [ ] Certified Copy of Priority Document(s)
- [ ] Reply to Missing Parts/ Incomplete Application
  - [ ] Reply to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Drawing(s)
- [ ] Licensing-related Papers
- [ ] Petition
- [ ] Petition to Convert to a Provisional Application
- [ ] Power of Attorney, Revocation Change of Correspondence Address
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- [ ] CD, Number of CD(s) ____________
  - [ ] Landscape Table on CD
- [ ] After Allowance Communication to TC
- [ ] Appeal Communication to Board of Appeals and Interferences
- [x] Appeal Communication to TC (**Appeal Notice, Brief, Reply Brief**) (BRIEF FOR APPELLANT)
- [ ] Proprietary Information
- [ ] Status Letter
- [x] Other Enclosure(s) (please Identify below):
  * Claims Appendix with Pending Claims
  * Evidence Appendix
  * Related Proceedings Appendix

Remarks

## SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

| | | | |
|---|---|---|---|
| Firm Name | Kolisch Hartwell, P.C. | | |
| Signature | | | |
| Printed name | David S. D'Ascenzo | | |
| Date | April 24, 2006 | Reg. No. | 39,952 |

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# FEE TRANSMITTAL
## For FY 2005

☐ Applicant claims small entity status. See 37 CFR 1.27

**TOTAL AMOUNT OF PAYMENT** ($) 500.00

| Complete if Known | |
|---|---|
| Application Number | 10/810,960 |
| Filing Date | March 25, 2004 |
| First Named Inventor | David J. Edlund |
| Examiner Name | Tracy Mae Dove |
| Art Unit | 1745 |
| Attorney Docket No. | NPW 357 |

**METHOD OF PAYMENT** (check all that apply)

☒ Check ☐ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): ____

☒ Deposit Account Deposit Account Number: 11-1540 Deposit Account Name: Kolisch Hartwell, P.C.

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☐ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, **except for the filing fee**

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**FEE CALCULATION**

**1. BASIC FILING, SEARCH, AND EXAMINATION FEES**

| | FILING FEES | | SEARCH FEES | | EXAMINATION FEES | | |
|---|---|---|---|---|---|---|---|
| Application Type | Fee ($) | Small Entity Fee ($) | Fee ($) | Small Entity Fee ($) | Fee ($) | Small Entity Fee ($) | Fees Paid ($) |
| Utility | 300 | 150 | 500 | 250 | 200 | 100 | |
| Design | 200 | 100 | 100 | 50 | 130 | 65 | |
| Plant | 200 | 100 | 300 | 150 | 160 | 80 | |
| Reissue | 300 | 150 | 500 | 250 | 600 | 300 | |
| Provisional | 200 | 100 | 0 | 0 | 0 | 0 | |

**2. EXCESS CLAIM FEES**

| Fee Description | Fee ($) | Small Entity Fee ($) |
|---|---|---|
| Each claim over 20 or, for Reissues, each claim over 20 and more than in the original patent | 50 | 25 |
| Each independent claim over 3 or, for Reissues, each independent claim more than in the original patent | 200 | 100 |
| Multiple dependent claims | 360 | 180 |

**Total Claims** ____ - 20 or HP = **Extra Claims** ____ x **Fee ($)** ____ = **Fee Paid ($)** ____

HP = highest number of total claims paid for, if greater than 20

**Indep. Claims** ____ - 3 or HP = **Extra Claims** ____ x **Fee ($)** ____ = **Fee Paid ($)** ____

HP = highest number of independent claims paid for, if greater than 3

**Multiple Dependent Claims**
**Fee ($)** ____ **Fee Paid ($)** ____

**3. APPLICATION SIZE FEE**

If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

**Total Sheets** ____ - 100 = **Extra Sheets** ____ / 50 = **Number of each additional 50 or fraction thereof** ____ (round **up** to a whole number) x **Fee ($)** ____ = **Fee Paid ($)** ____

**4. OTHER FEE(S)** **Fees Paid ($)**

Non-English Specification, $130 fee (no small entity discount) ____

Other: FEE FOR FILING A BRIEF IN SUPPORT OF AN APPEAL 500.00

**SUBMITTED BY**

| Signature | | Registration No. (Attorney/Agent) 39,952 | Telephone (503) 224-6655 |
|---|---|---|---|
| Name (Print/Type) | David S. D'Ascenzo | | Date April 24, 2006 |

AF
IFW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Date: April 24, 2006

In re Application of:

DAVID J. EDLUND, ARNE LaVEN,
WILLIAM A. PLEDGER and CURTISS RENN

| | | | |
|---|---|---|---|
| Serial No. | : | 10/810,960 | Group Art Unit: 1745 |
| Filed | : | March 25, 2004 | Examiner: Tracy Mae Dove |
| For | : | OXIDANT-ENRICHED FUEL CELL SYSTEM | |

**Mail Stop Appeal Brief - Patents**
Commissioner for Patents
PO Box 1450
Alexandria, Virginia 22313-1450

## BRIEF FOR APPELLANT

This is an appeal from the Examiner's June 9, 2005 final rejection of all presently pending claims in the present application. This brief is being submitted responsive to the March 24, 2006 Notice of Panel Decision from Pre-Appeal Brief Review, which indicated that at least one actual issue remains for appeal.

## REAL PARTY IN INTEREST

IdaTech, LLC, an Oregon LLC with a business address of 63065 NE 18th Street, Bend, Oregon 97701, is the Assignee of the present application and the real party in interest.

## RELATED APPEALS AND INTERFERENCES

U.S. Patent Application Serial No. 11/004,487 presently on appeal is commonly owned, has a common inventor, and relates very generally to the subject matter of the present application. However, the appealed claims of the '487 application are not related to the appealed claims of the present application except that they both generally relate to fuel cell systems. The

notice of appeal for the '487 application was filed on January 16, 2006, and the appeal brief was filed on March 16, 2006.

## STATUS OF CLAIMS

The present application was filed on March 25, 2004, with 43 claims. In Appellant's response to the first Office action, claims 1, 6, 7, 27, and 36 were amended, claims 44-68 were added, and claims 4-5, 11-12, 14-15, 17-18, 21-26, 30, 32, and 37-43 were cancelled without prejudice.

Claims 1-3, 6-10, 13, 16, 19-20, 27-29, 31, 33-36, and 44-68 are presently pending, rejected by the Examiner, and on appeal.

The rejections of all pending claims are traversed.

## STATUS OF AMENDMENTS

Appellant's amendment dated August 12, 2005, subsequent to the final Office action, was not entered by the Examiner, as indicated in the advisory action mailed August 30, 2005.

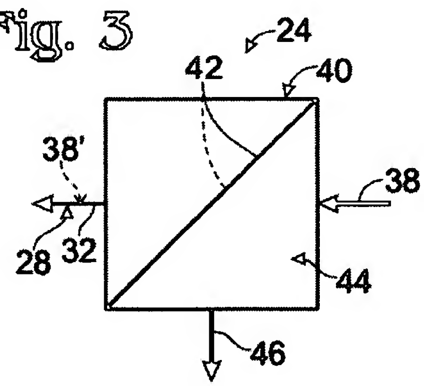
## SUMMARY OF CLAIMED SUBJECT MATTER

The pending claims are directed to fuel cell systems and methods of operating fuel cell systems. As discussed in the background of the present application, "[f]uel cells are electrochemical devices that produce an electric current and water through the electrochemical reaction of an oxidant and a fuel in the form of a proton source." [p. 1, lines 11-13]. Independent claims 1, 50, and 61 relate to fuel cell systems having a fuel processing assembly, an air delivery system, a fuel cell stack, and a water-recovery assembly. Independent claim 27 relates to a method of operating a fuel cell system including receiving an air stream, producing from the air stream an oxygen-enriched stream, delivering the oxygen-enriched stream to a cathode region of a fuel cell stack, recovering water from the cathode exhaust stream, and utilizing at least a

portion of the recovered water to produce additional fuel for the fuel stream. All of the pending claims, whether directed to fuel cell systems or methods of operating fuel cell systems, relate to fuel cells that use an oxygen-enriched stream produced from an air stream as the source of the oxidant.

Independent claims 1 and 27 recite an oxygen-selective membrane to produce the oxygen-enriched stream. Figure 3 of the present application, reproduced below, schematically illustrates an oxygen-enrichment assembly including at least one oxygen-selective membrane **42**. As discussed in the specification, "oxygen gas may permeate or otherwise pass [through the membrane], but . . . at least a portion (and preferably a substantial portion or all) of the other components of air stream **38** cannot pass [through the membrane]." [p. 14, lines 1-4]. "The portion of the air stream that passes through the membrane is used to form oxidant stream **28**, while the remaining portion of the air stream forms a byproduct stream **46** that has a reduced concentration of oxygen gas than was present in air stream **38**." [p. 14, lines 10-13].

Fig. 3




Dependent claims 45 and 48 (which respectively depend from claims 1 and 27) and independent claim 61 recite fuel cell systems (claims 45 and 61) and a method of operating a fuel cell system (claim 48), in which the byproduct stream that is produced from the oxygen-enrichment assembly is used to pressurize a supply of liquid fuel. In other words, the portion of

the air stream that is oxygen-depleted upon passing through the oxygen-enrichment assembly is used to provide pressure to a supply of liquid fuel (e.g., liquid carbon-containing feedstock that is consumed as a reactant by the fuel processing assembly to produce the product hydrogen stream, as recited in claims 46 and 61). An exemplar supply of liquid fuel is a pressurized tank, or other fuel reservoir, as discussed in the specification of the present application.

Independent claims 50 and 61 are similar to claims 1 and 27, in that they recite an oxygen-enrichment assembly that produces an oxygen-enriched stream from an air stream. However, and unlike claims 1 and 27, independent claims 50 and 61 do not specifically recite the use of an oxygen-selective membrane in the oxygen-enrichment assembly. As such, the oxygen-enrichment assemblies claimed "may be adapted to increase the relative concentration of oxygen gas 32 in oxidant stream 28 *via any suitable mechanism*." [p. 13, lines 18-20] (emphasis added).

## GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether claims 1-2, 7-10, 20, 27-29, 31, 33-35, 44, and 47 were properly rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 6,045,933 to Okamoto ("Okamoto") in view of U.S. Patent No. 6,627,338 to St-Pierre et al. ("St-Pierre").

2. Whether claims 3 and 6 were properly rejected under 35 U.S.C. § 103 as being unpatentable over Okamoto in view of St-Pierre.

3. Whether claims 13 and 16 were properly rejected under 35 U.S.C. § 103 as being unpatentable over Okamoto in view of St-Pierre and further in view of *Fuel Cell Systems*.

4. Whether claim 19 was properly rejected under 35 U.S.C. § 103 as being unpatentable over Okamoto in view of St-Pierre and further in view of U.S. Patent Application Publication No. 2001/0026884 to Appleby et al. ("Appleby").

5. Whether claims 45, 46, 48, and 49 were properly rejected under 35 U.S.C. § 103 as being unpatentable over Okamoto in view of St-Pierre and further in view of U.S. Patent No. 4,509,915 to Ito ("Ito").

6. Whether claims 50-57 were properly rejected under 35 U.S.C. § 103 as being unpatentable over Okamoto in view of St-Pierre and further in view of *Fuel Cell Systems*.

7. Whether claims 58 and 60 were properly rejected under 35 U.S.C. § 103 as being unpatentable over Okamoto in view of St-Pierre and further in view of *Fuel Cell Systems*.

8. Whether claim 59 was properly rejected under 35 U.S.C. § 103 as being unpatentable over Okamoto in view of St-Pierre and *Fuel Cell Systems* and further in view of Appleby.

9. Whether claims 61-66 and 68 were properly rejected under 35 U.S.C. § 103 as being unpatentable over Okamoto in view of St-Pierre and further in view of Ito.

10. Whether claim 67 was properly rejected under 35 U.S.C. § 103 as being unpatentable over Okamoto in view of St-Pierre and Ito and further in view of Appleby.

## ARGUMENT

### I. Rejections under 35 U.S.C. § 103 over Okamoto in view of St-Pierre.

As noted above, all of the pending claims were rejected based upon some combination of Okamoto and St-Pierre, whether alone or in combination with additional references. [*See* Final Office Action ("FOA") ¶¶4-13]. "To reject claims in an application under section 103, an examiner must show an unrebutted prima facie case of obviousness. In the absence of a proper prima facie case of obviousness, an applicant who complies with the other statutory requirements is entitled to a patent." *In re Rouffet*, 149 F.3d 1350, 1355 (Fed. Cir. 1998) (internal citations omitted).

To establish a prima facie case of obviousness, an examiner must establish the following three criteria: (i) there is some motivation or suggestion to modify the primary reference, (ii) there is a reasonable expectation of success, and (iii) the references must teach or suggest all of the claimed limitations. *In re Vaeck*, 947 F.2d 488 (Fed. Cir. 1991). The first of these requirements is not met when the references cited by an examiner teach away from the claims at issue in the application. *See McGinley v. Franklin Sports, Inc.*, 262 F.3d 1339, 1354 (Fed. Cir. 2001) (citing *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994)).

Furthermore, "[i]f references taken in combination would produce a 'seemingly inoperative device,'... such references teach away from the combination and thus cannot serve as predicates for a prima facie case of obviousness." *Id.* (internal citations omitted) (reversing a district court's JMOL setting aside a jury's finding of nonobvious of an instructional baseball because the defendant's proposed modification to the prior art would have rendered the primary reference inoperative). *See also In re Gordon*, 733 F.2d 900 (Fed. Cir. 1984) (reversing the Board's finding of obviousness of a blood filter assembly (turning it upside down) because the proposed modification of the prior art reference would have rendered it inoperative); *In re Sponnoble*, 405 F.2d 578 (CCPA 1969) (reversing the Board's finding of obviousness of an improved center seal plug which may be placed between the compartments of a pharmaceutical plural compartment mixing vial for temporarily isolating the same, in part because the proposed combination of the references would produce an inoperable device).

**A. Claims 1 and 27.**

In the case at hand, the Examiner failed to establish a prima facie case of obviousness of claims 1 and 27 because the references themselves teach away from the Examiner's proposed modification of Okamoto in view of St-Pierre. More specifically, the Examiner's proposed

modification of Okamoto in view of St-Pierre would create an inoperable device. Accordingly, Appellant submits that this error precludes a finding of obviousness based on these recited references.

Claims 1 and 27 were amended during prosecution and are reproduced below with emphasis added.

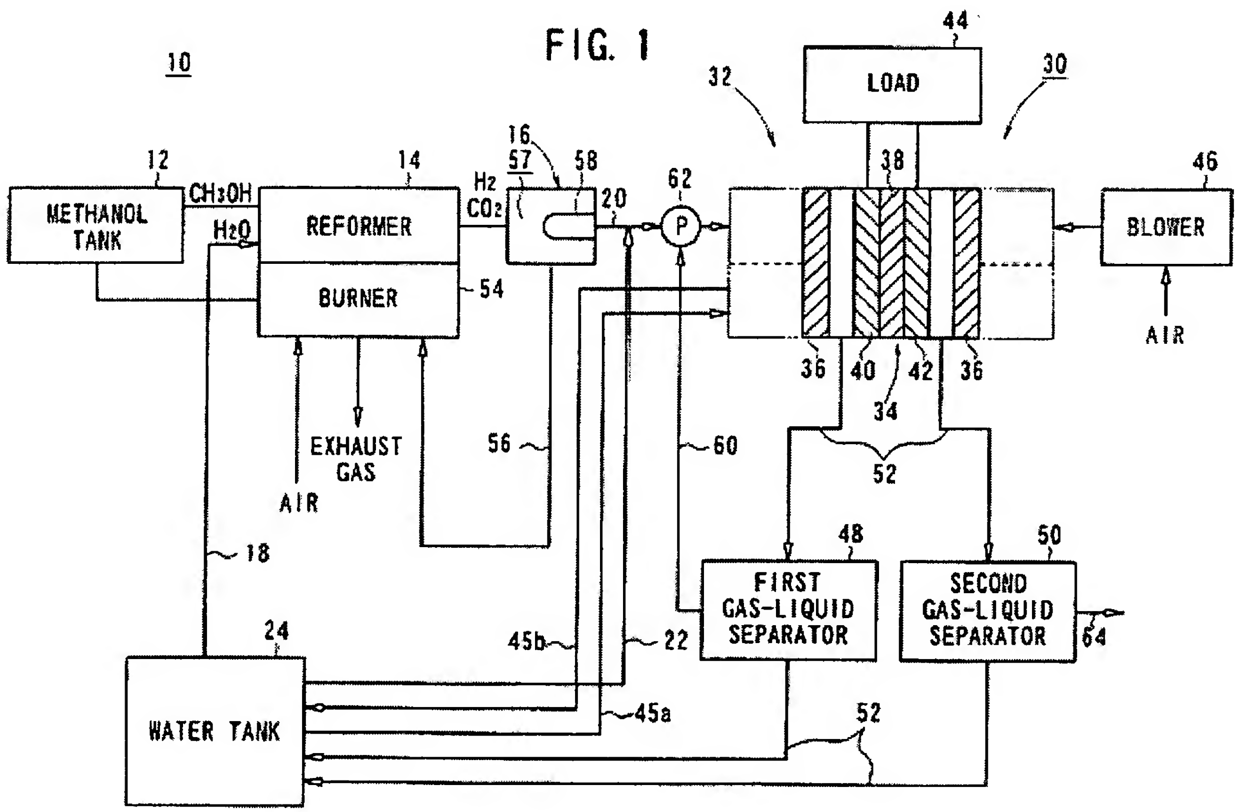
> 1. A fuel cell system, comprising:
>
> a fuel processing assembly adapted to produce a product hydrogen stream containing at least substantially pure hydrogen gas from at least one feed stream that comprises at least a carbon-containing feedstock;
>
> an air delivery system adapted to receive an air stream having a concentration of oxygen gas and to produce therefrom an oxygen-enriched stream having a greater concentration of oxygen gas than the air stream, wherein the air delivery system includes at least one oxygen-enrichment assembly adapted to produce the oxygen-enriched stream from the air stream, and further wherein the oxygen-enrichment assembly includes ***at least one oxygen-selective membrane***;
>
> a fuel cell stack adapted to receive at least a portion of the product hydrogen stream and the oxygen-enriched stream and to produce an electric current therefrom; wherein the fuel cell stack is adapted to emit a cathode exhaust stream containing water; and
>
> a water-recovery assembly adapted to receive the cathode exhaust stream and to produce a product water stream therefrom.

> 27. A method for operating a fuel cell system, the method comprising:
>
> receiving an air stream having a concentration of oxygen gas;
>
> producing from the air stream an oxygen-enriched stream containing a higher concentration of oxygen gas than the concentration of oxygen gas in the air stream, wherein the producing step occurs in ***at least one oxygen-selective membrane assembly*** adapted to receive the air stream and to produce therefrom the oxygen-enriched stream and a byproduct stream having a lower concentration of oxygen gas than the concentration of oxygen gas in the air stream;
>
> delivering the oxygen-enriched stream to a cathode region of a fuel cell stack adapted to produce an electric current and water from the oxygen-enriched stream and a fuel stream, wherein the fuel cell stack is adapted to exhaust at least a cathode exhaust stream containing water;
>
> recovering water from the cathode exhaust stream; and
>
> utilizing at least a portion of the recovered water to produce additional fuel for the fuel stream.

As indicated, claims 1 and 27 recite, amongst other subject matter, "at least one oxygen-selective membrane." To arrive at the claimed subject matter, the Examiner proposes to combine "the fuel cell system as taught by Okamoto [with] the reactant enrichment membrane for oxygen as taught by St-Pierre et al." [FOA ¶4, p. 3].

Okamoto discloses several configurations of fuel cell systems. Fig. 1 of Okamoto, reproduced below, illustrates an exemplary embodiment.

FIG. 1




With reference to the above figure, the system of Okamoto includes a fuel cell **30** that is supplied with hydrogen gas via a hydrogen gas passage **20** from a fuel processor **14**. A blower **46** provides atmospheric air to the cathode side **42** of the fuel cell. Notably, each embodiment disclosed in Okamoto shows that the element corresponding to **46** is described only as a "blower **46** for introducing atmospheric air." (*See, e.g.,* col. 3, line 9). This construction is an energy-

efficient design in which the fuel cell is supplied with atmospheric air obtained from proximate the fuel cell system. In other words, fuel cell systems of the type disclosed in Okamoto simply blow atmospheric air over the cathode side of the fuel cell stack.

St-Pierre, on the other hand, is directed to integrated fuel-cell and pressure swing adsorption systems. Pressure swing adsorption is a method for producing concentrated reactant streams for fuel cells, (*see* col. 2, lines 58-61), and the bulk of the St-Pierre disclosure is directed to such methods. St-Pierre does mention, in passing, that "[s]everal enrichment methods are commonly known that involve separating out a component from the reactant stream, including ... membrane ... methods." (Col. 2, lines 58-61). St-Pierre briefly goes on to state that "[i]n a membrane method, component separation is achieved by passing the stream over the surface of a membrane that is selectively permeable to a component in the stream." (Col. 2, lines 63-66). No further discussion of a membrane or oxygen-specific membrane is provided.

As mentioned, the Examiner proposes to combine the reactant membrane of St-Pierre with the blower-based air delivery system of Okamoto to arrive at Appellant's claims 1 and 27. However, if such a modification to Okamoto were made, the resultant device would be inoperable, thus precluding a finding of obviousness of claims 1 and 27. As noted in the specification of the present application, the utilization of an oxygen-selective membrane to increase the oxygen content of oxidant air is a "pressure-driven separation process," [p. 13, line 22 – p. 14, line 1], that occurs "at a pressure greater than atmospheric pressure, such as a pressure of at least 2 bara." [p. 14, lines 8-9].

As noted above, the air supply mechanism of Okamoto is strictly limited to being a *blower* of atmospheric air (i.e., air at atmospheric pressure). Therefore the proposed combination would be inoperable to achieve the at least 2 bara pressure required for the pressure-

driven separation process used in conjunction with an oxygen-selective membrane as claimed in claims 1 and 27.

In other words, for an oxygen-enrichment assembly that relies upon at least one oxygen-selective membrane to separate an air stream into a satisfactory oxygen-enriched air stream for a fuel cell stack, the air stream must be supplied to the oxygen-enrichment assembly at an elevated pressure. However, Okamoto is specifically directed to low-pressure, low complexity air delivery systems that merely require a blower to transport air from proximate the fuel cell stack to the cathode region of the fuel cell stack. Accordingly, the proposed inclusion of a membrane-based oxygen-enrichment assembly to the system of Okamoto would render the system inoperative because the system would not produce the desired oxygen-enriched air stream.

Accordingly, the Examiner has failed to establish a prima facie case of obviousness of claims 1 and 27, and Appellant respectfully requests reversal of the final Office action with respect to these claims.

**B. Claims 2-3, 6-10, 13, 16, 19-20, 28-29, 31, 33-36, and 44-49.**

Claims 2-3, 6-10, 13, 16, 19-20, and 44-49 depend from independent claim 1, and claims 28-29, 31, and 33-36 depend from independent claim 27. Therefore, for at least the reasons stated above, the Examiner has also failed to establish a prima facie case of obviousness with respect to these claims, and Appellant respectively requests reversal of the final Office with respect to these claims.

**C. Claims 2, 7-10, 20, 28-29, 31, 33-35, 44, and 47.**

Dependent claims 2, 7-10, 20, 28-29, 31, 33-35, 44, and 47 were not addressed in the Examiner's final Office action. "To reject claims in an application under section 103, an examiner must show an unrebutted prima facie case of obviousness.... On appeal to the Board,

an applicant can overcome a rejection by showing insufficient evidence of prima facie obviousness ...." *In re Rouffet*, 149 F.3d 1350, 1355 (Fed. Cir. 1998) (internal citations omitted).

In the cased at hand, the Examiner presented insufficient evidence in the final Office action as to the obviousness of claims 2, 7-10, 20, 28-29, 31, 33-35, 44, and 47 when the Examiner failed to provide *any* arguments with respect to these claims. Therefore, the Examiner did not establish a prima facie case of obviousness. Accordingly, Appellant respectively requests reversal of the rejections of these claims.

**D. Claims 50 and 61.**

Claims 50 and 61 stand rejected as being unpatentable over the combination of Okamoto and St-Pierre in view of other references. [*See* FOA ¶¶9 and 12]. As with claims 1 and 27, which are discussed above, the Examiner failed to establish a prima facie case of obviousness of claims 50 and 61 because the references teach away from the Examiner's proposed modification of Okamoto in view of St-Pierre. More specifically, the Examiner's proposed modification of Okamoto in view of St-Pierre would create an inoperable device, thereby precluding a finding of obviousness in the present case.

Independent claims 50 and 61 were added during prosecution and are reproduced below with emphasis added.

> 50. A fuel cell system, comprising:
>
> a fuel processing assembly adapted to produce a product hydrogen stream containing at least substantially pure hydrogen gas from at least one feed stream comprising at least a carbon-containing feedstock;
>
> an air delivery system adapted to receive an air stream having a concentration of oxygen gas and to produce therefrom an oxygen-enriched stream having a greater concentration of oxygen gas than the air stream, wherein the air delivery system includes ***at least one oxygen-enrichment assembly*** adapted to produce the oxygen-enriched stream from the air stream;
>
> a fuel cell stack adapted to receive at least a portion of the product hydrogen stream, the oxygen-enriched stream and a secondary air stream and to

produce an electric current therefrom, wherein the fuel cell stack is adapted to emit a cathode exhaust stream containing water; and

a water-recovery assembly adapted to receive the cathode exhaust stream and to produce a product water stream therefrom.

61. A fuel cell system, comprising:

a fuel processing assembly adapted to produce a product hydrogen stream containing at least substantially pure hydrogen gas from at least one feed stream, wherein the at least one feed stream includes a carbon-containing feedstock from a supply of liquid fuel;

an air delivery system adapted to receive an air stream having a concentration of oxygen gas and to produce therefrom an oxygen-enriched stream having a greater concentration of oxygen gas than the air stream and a byproduct stream having a lower concentration of oxygen gas than the air stream, wherein the air delivery system includes ***at least one oxygen-enrichment assembly*** adapted to produce the oxygen-enriched stream from the air stream, and further wherein the byproduct stream is used to pressurize the supply of liquid fuel;

a fuel cell stack adapted to receive at least a portion of the product hydrogen stream and the oxygen-enriched stream and to produce an electric current therefrom; wherein the fuel cell stack is adapted to emit a cathode exhaust stream containing water; and

a water-recovery assembly adapted to receive the cathode exhaust stream and to produce a product water stream therefrom.

As indicated, claims 50 and 61 recite "at least one oxygen-enrichment assembly adapted to produce the oxygen-enriched stream from the air stream," and therefore do not recite the use of an oxygen-selective membrane, as do claims 1 and 27 discussed above. As such, the oxygen-enrichment assembly claimed "may be adapted to increase the relative concentration of oxygen gas 32 in oxidant stream 28 *via any suitable mechanism*." [p. 13, lines 18-20] (emphasis added). However, the Examiner's proposed modification of Okamoto in view of St-Pierre is premised on the same modification discussed above in regards to claims 1 and 27 – that is, the combination of the membrane of St-Pierre with the low-pressure, low complexity air delivery systems of Okamoto. [*See* FOA ¶¶9 and 12]. As established above, the proposed inclusion of a membrane-based oxygen-enrichment assembly to the system of Okamoto would render the system inoperative because the system would not produce the desired oxygen-enriched air stream.

Accordingly, the Examiner has failed to establish a prima facie case of obviousness of claims 50 and 61, and Appellant respectfully requests reversal of the final Office action with respect to these claims.

**E. Claims 51-60 and 62-68.**

Claims 51-60 and 62-68 (dependent from claims 50 and 61, respectively) were all rejected based upon the same combination of Okamoto and St-Pierre just discussed. [*See* FOA ¶¶9-13]. Therefore, for at least the reasons stated above, the Examiner has also failed to establish a prima facie case of obviousness with respect to these claims, and Appellant respectively requests reversal of the final Office action with respect to these claims.

## II. Rejections under 35 U.S.C. § 103 over Okamoto in view of St-Pierre and further in view of Ito.

**A. Claims 45, 48, and 61.**

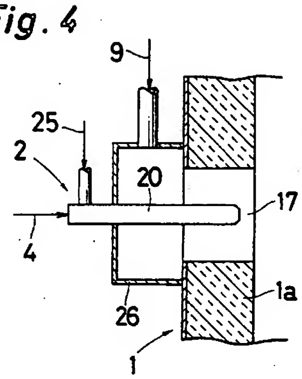
Again, a prima facie case of obviousness requires an Examiner to establish the following three criteria: (i) there is some motivation or suggestion to modify the primary reference, (ii) there is a reasonable expectation of success, and (iii) the references must teach or suggest all of the claimed limitations. *In re Vaeck*, 947 F.2d 488 (Fed. Cir. 1991). With regards to claims 45, 48, and 61, the Examiner failed to establish the third criteria – that all of the claimed limitations are taught or suggested in the prior art references.

Claim 45 depends from independent claim 1. Claim 48 depends from independent claim 27. Claims 45, 48, and 61 recite fuel cell systems (claims 45 and 61) and a method of operating a fuel cell system (claim 48), wherein the byproduct stream produced from the oxygen-enrichment assembly is used *to pressurize a supply of liquid fuel*. In other words, the portion of the air stream that is oxygen-depleted upon passing through the oxygen-enrichment assembly, is

used to provide pressure to a supply of liquid fuel (e.g., liquid carbon-containing feedstock that is consumed as a reactant by the fuel processing assembly to produce the product hydrogen stream, as recited in claims 46 and 61). An exemplar supply of liquid fuel is a pressurized tank, or other fuel reservoir, as discussed in the specification of the present application.

The Examiner proposes to further modify the above-discussed inoperative combination of Okamoto and St-Pierre with the fuel-atomizing system of Ito. Ito is directed to a liquid fuel combustion apparatus that utilizes heavy oil as an exemplar fuel source. (Col. 1, lines 20-30). Ito discloses using nitrogen-enriched (i.e., oxygen-depleted) air from an oxygen-enriched air generating means **8** for atomizing the fuel (e.g., heavy oil) delivered to the burner **2** and thus provide for better combustion. (Col. 3, line 44 – col. 4, line 42). Figure 4 of Ito, reproduced below, shows the nitrogen-enriched stream being delivered via pipe conduit **25** to the fuel spraying cylinder **20** of burner **2**, where it atomizes a fuel stream delivered via fuel supply pipe **4** to the fuel spraying cylinder **20**.

*Fig. 4*




Ito simply does not disclose pressuring a supply of fuel with the oxygen-depleted stream from an oxygen-enrichment assembly. Therefore, Ito fails to disclose or suggest a byproduct stream produced from an oxygen-enrichment assembly for pressurizing a supply of liquid fuel as recited in claims 45, 48, and 61.

Accordingly, the Examiner failed to establish a prima facie case of obviousness of claims 45, 48, and 61, and Appellant respectively requests reversal of the final Office action with respect to these claims.

**B. Claims 46, 49, and 62-68.**

Claims 46, 49, and 62-68 (dependent from claims 45, 48, and 61, respectively) were all rejected based upon the same combination of Okamoto, St-Pierre, and Ito discussed above. [*See* FOA ¶¶8, 12, and 13]. Therefore, for at least the reasons stated above, the Examiner has also failed to establish a prima facie case of obviousness with respect to these claims, and Appellant respectively requests reversal of the final Office action with respect to these claims.

## CONCLUSION

Appellant submits that the above discussion clearly demonstrates that the rejections at issue were improper and that all presently pending claims patentably distinguish the cited prior art and are in proper form. Therefore, Appellant requests that the Examiner's rejections of the pending claims be reversed.

Respectfully submitted,

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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Date: April 24, 2006

In re Application of:

DAVID J. EDLUND, ARNE LaVEN,
WILLIAM A. PLEDGER and CURTISS RENN

| | | | |
|---|---|---|---|
| Serial No. | : | 10/810,960 | Group Art Unit: 1745 |
| Filed | : | March 25, 2004 | Examiner: Tracy Mae Dove |
| For | : | OXIDANT-ENRICHED FUEL CELL SYSTEM | |

**Appeal Brief - Patents**
Commissioner for Patents
PO Box 1450
Alexandria, Virginia 22313-1450

## RELATED PROCEEDING APPENDIX

NONE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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## CLAIMS APPENDIX WITH PENDING CLAIMS

1. (Previously Presented) A fuel cell system, comprising:

a fuel processing assembly adapted to produce a product hydrogen stream containing at least substantially pure hydrogen gas from at least one feed stream that comprises at least a carbon-containing feedstock;

an air delivery system adapted to receive an air stream having a concentration of oxygen gas and to produce therefrom an oxygen-enriched stream having a greater concentration of oxygen gas than the air stream, wherein the air delivery system includes at least one oxygen-enrichment assembly adapted to produce the oxygen-enriched stream from the air stream, and further wherein the oxygen-enrichment assembly includes at least one oxygen-selective membrane;

a fuel cell stack adapted to receive at least a portion of the product hydrogen stream and the oxygen-enriched stream and to produce an electric current therefrom; wherein the fuel cell stack is adapted to emit a cathode exhaust stream containing water; and

a water-recovery assembly adapted to receive the cathode exhaust stream and to produce a product water stream therefrom.

2. (Original) The system of claim 1, wherein the at least one feed stream further comprises water.

3. (Original) The system of claim 2, wherein the product water stream forms at least 50% of the water present in the at least one feed stream.

4-5. (Cancelled)

6. (Previously Presented) The system of claim 1, wherein the product water stream forms at least 50% of the water present in the at least one feed stream.

7. (Previously Presented) The system of claim 1, wherein the fuel processing assembly is adapted to produce the product hydrogen stream by steam reforming of the at least one feed stream.

8. (Original) The system of claim 1, further comprising at least one separation region adapted to selectively reduce the concentration of impurities present in the product hydrogen stream.

9. (Original) The system of claim 1, wherein the oxygen-enrichment assembly is adapted to selectively remove at least nitrogen gas from the air stream.

10. (Original) The system of claim 1, wherein the oxygen-enrichment assembly is adapted to separate the air stream into the oxygen-enriched stream having a greater concentration of oxygen gas than the concentration of oxygen gas in the air stream and an oxygen-depleted stream containing a greater concentration of nitrogen gas than present in the air stream.

11-12. (Cancelled)

13. (Original) The system of claim 1, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream containing at least 30% oxygen.

14-15. (Cancelled).

16. (Original) The system of claim 1, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having a concentration of oxygen gas that is at least 50% greater than the concentration of oxygen gas in the air stream.

17-18. (Cancelled)

19. (Original) The system of claim 1, wherein the water-recovery assembly is adapted to deliver the product water stream to a potable water supply.

20. (Original) The system of claim 1, wherein the fuel processing assembly is adapted to receive and utilize at least a portion of the at least one feed stream and at least a portion of the product water stream.

21-26. (Cancelled)

27. (Previously Presented) A method for operating a fuel cell system, the method comprising:

receiving an air stream having a concentration of oxygen gas;

producing from the air stream an oxygen-enriched stream containing a higher concentration of oxygen gas than the concentration of oxygen gas in the air stream, wherein the producing step occurs in at least one oxygen-selective membrane assembly adapted to receive the air stream and to produce therefrom the oxygen-enriched stream and a byproduct stream having a lower concentration of oxygen gas than the concentration of oxygen gas in the air stream;

delivering the oxygen-enriched stream to a cathode region of a fuel cell stack adapted to produce an electric current and water from the oxygen-enriched stream and a fuel stream, wherein the fuel cell stack is adapted to exhaust at least a cathode exhaust stream containing water;

recovering water from the cathode exhaust stream; and

utilizing at least a portion of the recovered water to produce additional fuel for the fuel stream.

28. (Original) The method of claim 27, wherein the fuel is hydrogen gas and the fuel stream contains at least substantially pure hydrogen gas.

29. (Original) The method of claim 27, wherein the producing step includes producing an oxygen-enriched stream containing at least 30% oxygen.

30. (Cancelled)

31. (Original) The method of claim 27, wherein the producing step includes producing an oxygen-enriched stream having a concentration of oxygen gas that is at least 50% as great as the concentration of oxygen gas in the air stream.

32. (Cancelled)

33. (Original) The method of claim 27, wherein the fuel is hydrogen gas, the fuel stream includes at least water, and the utilizing step includes producing hydrogen gas from at least one feed stream, with the at least one feed stream including water recovered from the cathode exhaust stream.

34. (Original) The method of claim 33, wherein the at least one feed stream further comprises at least one carbon-containing feedstock.

35. (Original) The method of claim 34, wherein the utilizing step includes producing hydrogen gas by steam reforming water and the at least one carbon-containing feedstock.

36. (Previously Presented) The method of claim 27, wherein the utilizing includes producing the additional fuel from at least one feed stream comprising the portion of the recovered water and at least one carbon-containing feedstock in a hydrogen-producing region of a fuel processing assembly.

37-43. (Cancelled)

44. (Previously Presented) The system of claim 1, wherein the oxygen-enrichment assembly is adapted to at least selectively reduce the concentration of air pollutants from the air stream.

45. (Previously Presented) The system of claim 1, wherein the oxygen-enrichment assembly is further adapted to produce from the air stream a byproduct stream having a lower concentration of oxygen gas than the air stream, and further wherein the system is adapted to utilize the byproduct stream to pressurize a supply of liquid fuel.

46. (Previously Presented) The system of claim 45, wherein the feed stream includes fuel from the supply of liquid fuel, and further wherein the fuel includes at least one carbon-containing feedstock.

47. (Previously Presented) The method of claim 27, wherein the oxygen-enrichment assembly is adapted to at least selectively reduce the concentration of air pollutants from the air stream.

48. (Previously Presented) The method of claim 34, wherein the method further comprises pressurizing a supply of liquid fuel with the byproduct stream.

49. (Previously Presented) The method of claim 48, wherein the at least one carbon-containing feedstock includes a fuel from the supply of liquid fuel.

50. (Previously Presented) A fuel cell system, comprising:

a fuel processing assembly adapted to produce a product hydrogen stream containing at least substantially pure hydrogen gas from at least one feed stream comprising at least a carbon-containing feedstock;

an air delivery system adapted to receive an air stream having a concentration of oxygen gas and to produce therefrom an oxygen-enriched stream having a greater concentration of oxygen gas than the air stream, wherein the air delivery system includes

at least one oxygen-enrichment assembly adapted to produce the oxygen-enriched stream from the air stream;

a fuel cell stack adapted to receive at least a portion of the product hydrogen stream, the oxygen-enriched stream and a secondary air stream and to produce an electric current therefrom, wherein the fuel cell stack is adapted to emit a cathode exhaust stream containing water; and

a water-recovery assembly adapted to receive the cathode exhaust stream and to produce a product water stream therefrom.

51. (Previously Presented) The system of claim 50, wherein at least the oxygen-enrichment assembly includes at least one pressure swing adsorption assembly adapted to produce the oxygen-enriched stream from the air stream.

52. (Previously Presented) The system of claim 50, wherein the oxygen-enriched stream and the secondary air stream are received by the fuel cell stack as a mixed air stream.

53. (Previously Presented) The system of claim 50, wherein the oxygen-enriched stream and the secondary air stream are received by the fuel cell stack as separate air streams.

54. (Previously Presented) The system of claim 50, wherein at least the oxygen-enrichment assembly includes at least one oxygen-selective membrane assembly adapted to produce the oxygen-enriched stream from the air stream.

55. (Previously Presented) The system of claim 50, wherein the at least one feed stream further comprises water from the product water stream.

56. (Previously Presented) The system of claim 50, wherein the fuel processing assembly is adapted to produce the product hydrogen stream by steam reforming of the at least one feed stream.

57. (Previously Presented) The system of claim 50, further comprising at least one separation region adapted to selectively reduce the concentration of impurities present in the product hydrogen stream.

58. (Previously Presented) The system of claim 50, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream containing at least 30% oxygen.

59. (Previously Presented) The system of claim 50, wherein the water-recovery assembly is adapted to deliver the product water stream to a potable water supply.

60. (Previously Presented) The system of claim 50, wherein the oxygen-enrichment assembly is adapted to at least selectively reduce the concentration of air pollutants from the air stream.

61. (Previously Presented) A fuel cell system, comprising:

a fuel processing assembly adapted to produce a product hydrogen stream containing at least substantially pure hydrogen gas from at least one feed stream, wherein the at least one feed stream includes a carbon-containing feedstock from a supply of liquid fuel;

an air delivery system adapted to receive an air stream having a concentration of oxygen gas and to produce therefrom an oxygen-enriched stream having a greater concentration of oxygen gas than the air stream and a byproduct stream having a lower

concentration of oxygen gas than the air stream, wherein the air delivery system includes at least one oxygen-enrichment assembly adapted to produce the oxygen-enriched stream from the air stream, and further wherein the byproduct stream is used to pressurize the supply of liquid fuel;

a fuel cell stack adapted to receive at least a portion of the product hydrogen stream and the oxygen-enriched stream and to produce an electric current therefrom; wherein the fuel cell stack is adapted to emit a cathode exhaust stream containing water; and

a water-recovery assembly adapted to receive the cathode exhaust stream and to produce a product water stream therefrom.

62. (Previously Presented) The system of claim 61, wherein the oxygen-enrichment assembly includes at least one oxygen-selective membrane.

63. (Previously Presented) The system of claim 61, wherein the at least one feed stream comprises water from the product water stream.

64. (Previously Presented) The system of claim 61, wherein the fuel processing assembly is adapted to produce the product hydrogen stream by steam reforming of the at least one feed stream.

65. (Previously Presented) The system of claim 61, wherein the oxygen-enrichment assembly is adapted to selectively remove at least nitrogen gas from the air stream.

66. (Previously Presented) The system of claim 61, wherein the oxygen-enrichment assembly includes at least one pressure swing adsorption assembly adapted to produce the oxygen-enriched stream from the air stream.

67. (Previously Presented) The system of claim 61, wherein the water-recovery assembly is adapted to deliver the product water stream to a potable water supply.

68. (Previously Presented) The system of claim 61, wherein the oxygen-enrichment assembly is adapted to at least selectively reduce the concentration of air pollutants from the air stream.

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## EVIDENCE APPENDIX

The attached reference entitled "Fuel Cell Systems" was entered into the record by the Examiner in the Notice of References Cited accompanying the first Office action dated November 16, 2004. The attached reference is a copy of the reference as provided by the Examiner.

# *Fuel Cell Systems*

Edited by

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makes more high-quality heat available to all other cold streams, and thus enables a simpler and cheaper heat exchanger network design. In fact, a reduction of the number of heat exchangers from 12 to 9 is achieved, resulting in a flowsheet depicted in Fig. 6.18.

Other optimization studies using pinch technology have shown that better power plant performance and reduced system complexity are obtained as the maximum steam pressure level in the system is raised from 10 to 40 bar abs. This is because a simpler heat exchanger network design becomes possible and because of improvements in steam turbine performance.

## 6.5. PROCESS OPTIONS

Aside from the generic fuel cell systems designs outlined in the previous section, it may also be economical to apply one of several process options. These may include the enrichment in oxygen of airstreams, the use of depleted cathode air as reformer combustion air, or, in MCFC systems, the use of sophisticated technologies for the recovery of carbon dioxide. In general, the application of such process options may only be economically feasible for specific battery-lim conditions or in multi-$MW_e$ fuel cell power plants.

### 6.5.1. Oxygen Enrichment

Oxygen-enriched cathode and combustion air may be used in any type of cell system. In general, its advantages include a rise in fuel cell efficiency due to an increase in the partial pressure of oxygen at the cathode of the fuel Further, the reduction of inerts, such as nitrogen, at the reformer burner le an increase in the adiabatic flame temperature with a consequent improvem the radiant box efficiency (Section 6.4.1.3). However, higher flame temper can also result in higher $NO_x$ emissions, the level of which is dependent the concentration of nitrogen at the burner (see Section 6.11). The major di tage of oxygen enrichement is that the additional power demand to ef separation of oxygen from air more than offsets the reduction in compression requirements on account of diminished gas flows. In addi reduction of circulating inerts in the fuel cell system results in lower flows of hot flue gases to drive the fuel cell system power recovery exp

Oxygen-enriched airstreams may be sourced from PSA, mem cryogenic units dedicated to oxygen production. Alternatively, oxy waste gases can also originate from a nitrogen PSA plant.

System optimization studies have been performed using a PSA produces a 90% purity oxygen stream from air for an electric powe of 0.6 kW · h/Nm$^3$ of oxygen,[60] and a membrane-based system pr purity oxygen stream at 0.175 kW · h/Nm$^3$ of oxygen (i.e., membrane technology).[61,62] The oxygen-enriched stream may be air to produce oxidant gases with oxygen concentrations rangin 90%. Figure 6.19 shows the effect of changing oxygen conten airstream on the system efficiencies of a 250-$kW_e$ PAFC powe

It is concluded that with state-of-the-art power consumptio enrichment is economically unattractive for stand-alone PA